

GemLine TOPAZ SPECIFICATIONS



October 1998

Philips
Electronic Manufacturing
Technology



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1.0 Introducing the Gem Topaz

The Topaz is a member of the top-of-the-line GemLine of Philips' SMD Pick & Place machines. The Topaz is a flexible, medium volume chip-shooter that can handle a wide range of components at speeds up to 14,000 SMDs per hour. The machine is built around a very rigid, vibration-free frame for improved accuracy and long-term stability and is perfectly suitable for round-the-clock production.

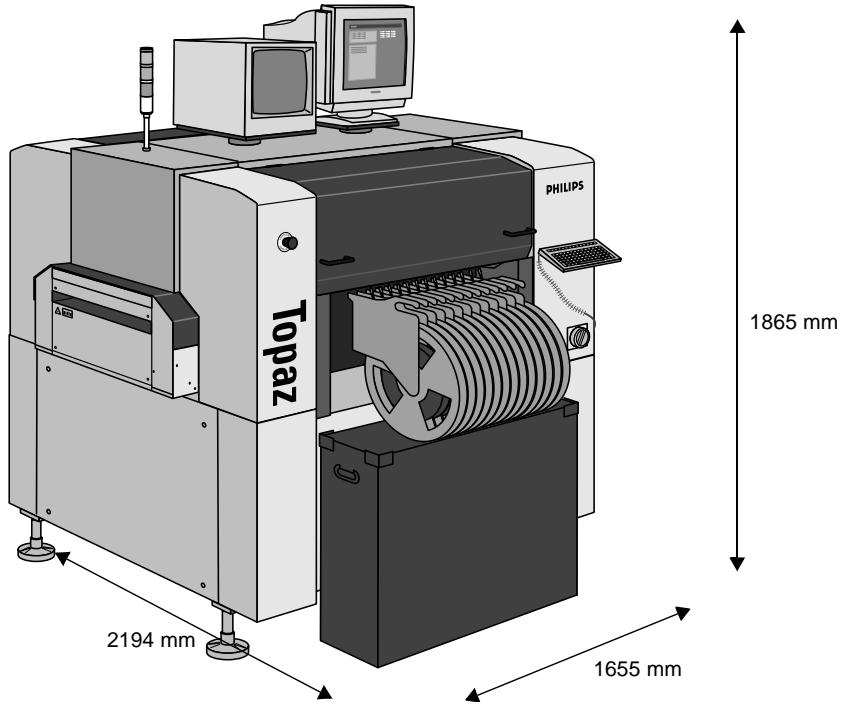


Figure 1 Front view Gem Topaz.

The Gem Topaz features a high precision single placement beam carrying 8 heads with exchangeable nozzles, one of which is specially designed for high precision QFP placement. The placement beam moves in X/Y and Z direction, while the board and component feeders are stationary. A flexible board transport system enables the Topaz to handle virtually any type of PCB, with or without tooling pins. Board conveyor width is automatically adjustable, allowing board dimensions up to 457 x 407 mm (18" x 16") to be handled.

The newly designed vision system with line sensor camera allows fast and accurate “on-the-fly” alignment of a wide range of components from 0402 up to 25 mm square PLCC, including 21 mm square ICs with lead pitches down to 0.65 mm (25 mil).

An optional area CCD camera, in combination with the precision head, extends the component range to 32 mm square ICs with lead pitches down to 0.5 mm (20 mil). The vision system detects missing, bent or irregular spaced leads or BGA balls; faulty components are rejected.

A separate camera system monitors fiducial marks at board, circuit and component level, using white-light LEDs and multi-angle diffusers to provide optimal illumination.

Just five nozzle shapes are required to cover the specified SMD range. High output levels are therefore achieved, as the need for nozzle exchanges is minimal. An optional 12 position nozzle exchange station enables additional special nozzles to be accommodated.

Up to 100 tape feeders can be loaded on the Gem Topaz. The machine supports tape, stick, bulk and tray feeders. The tape feeder design for the Gem Topaz allows simultaneous picking from any mix of tape feeders ranging from 8 to 56 mm.

An industrial PC controller, running Philips' well proven and user-friendly software, allows the Gem Topaz to be used stand-alone or in-line. The controller includes a Management Information System (MIS) that continuously gathers production data for management feedback. The unique bad mark sensing capabilities allow a multi-circuit panel to be run as one large board, thus maximizing placement speed while still using bad mark information.

A basic program optimization function is included in the machine as standard. For more advanced machine optimization and/or line balancing, the off-line Philips Computer Aided Production Support System (CAPSS) is available.

The Gem Topaz is fully compatible with the Sapphire and Emerald, which use the same feeders, feederbars, software and controller. A laser-based verification system, which guarantees correct feeder latching, is standard. Off-line feeder changeover can be achieved by using a Feederbar Exchange System (FES). An entire feederbar can be conveniently loaded off-line, minimizing change-over time. An optional Set-up Verification System (SVS) guides the operator through placing the appropriate components at the correct supply position. A scanner checks the barcode on the reels and sticks, while sensors in the feederbars verify the correct feeder location.

2.0 General Specifications

Gem Topaz		
		REMARKS
Optimal placement rate:	14,000 cph	Simultaneous pick
Nominal placement rate:	9,000 - 11,000 cph	
Applicable Components:	0402 - SOP, SOJ, PLCC 25 mm \square (1.0") QFP 21 mm \square (0.83") with pin pitch down to 0.65 mm (25 mil) QFP 32 mm \square (1.26") with pin pitch down to 0.5 mm (20 mil) Max. component height: 6.5 mm	Line sensor camera system Line sensor camera system Optional area CCD camera system
Mounting accuracy: (x,y) 3σ	0.08 mm for chips and SOIC 0.06 mm for QFPs	Line sensor camera system Using Precision Head and optional area CCD camera system
Mounting angle:	0 up to ± 180 (steps of 0.01)	
Alignment system:	Line sensor camera with fore light system for Vision-on-the-Fly; image processing by VICS 2500 proprietary vision system Area CCD camera for fine pitch components Area CCD camera for fiducial alignment	Second Line sensor camera for rear side is optional (Max. Board width is limited to 300 mm (11.8")) Optional Standard
Type of nozzles:	Type 31 Type 31-1 (Precision Head only, spring loaded) Type 32-2 Type 33 Type 34 Type MELF	The nozzle types for Topaz and Emerald are the same. Standard will be delivered: 7x nozzle 31, 1x nozzle 31-1, 2x nozzle 32-2, 1x nozzle 33, 1x nozzle 34, 1x nozzle MELF
Nozzle exchange station:	12 nozzle positions	Optional (No nozzles included)
Number of heads:	One single beam with 8 exchangeable nozzles	Including one Precision Head
Placement heads actuation method:	Pneumatic or servo controlled for component height compensation	
Number of feeders:	Tapefeeders: 8 mm: 100 positions 12 mm: 48 positions 16 mm: 48 positions 24 mm: 32 positions 32 mm: 32 positions 44 mm: 24 positions 56 mm: 18 positions Stick feeders: Depends on stick dimensions Bulk feeders: 100 x 8 mm positions	

Gem Topaz

Gem Topaz		REMARKS
Component Packaging:	Tape according to IEC/EIA-J/JEDEC: 8-56 mm	Tape reel diameter max: 380 mm (15")
	Manual Tray feeder: Max. tray size 320 mm x 320 mm (12.6" x 12.6")	Optional: Manual tray feeder (Second line sensor camera not possible; amount of rear side feeder positions limited)
	Fixed Manual Tray Feeder: Max. tray size 635 mm x 136 mm (25" x 5.3")	Optional: Fixed manual tray feeder (Max. board size 250 mm (10"); second line sensor camera not possible)
	For other Multi-Manual Tray Feeder options, please contact your local sales representative	
	ATS 27 Tray Feeder: Max. tray size 364 mm x 222 mm (14.3" x 8.7")	Optional: ATS 27 tray feeder (Max. board size 250 mm (10"); second line sensor camera not possible)
	LCS Tray Feeder: Max. tray size 350 mm x 468 mm (13.7" x 18.4")	Optional: LCS tray feeder (no restrictions)
	Stick and bulk	
Maximum height pre-mounted components:	6.5 mm on placement side (0.26") 15 mm on non-placement side (0.6")	
PCB Dimensions (x,y):	Min: 50 mm x 50 mm (2.0" x 2.0") Max: 457 mm x 407 mm (18" x 16") using PCB pin fixation Max: 440 mm x 407 mm (17.3" x 16") using PCB edge clamping system	Optional 558 mm x 508 mm (22" x 20"). However, Line sensor camera & nozzle station mounted at machine REAR side. No second line sensor camera possible. Amount of rear side feeder positions limited. Special LCS required.
PCB Thickness:	Min. 0.6 mm (0.02") Max. 3.0 mm (0.12")	Special applications upon request
Non-mountable area:	Board Top side: 3 mm from rear side board edge (0.12") 0 mm from front side board edge 3 mm around reference holes (0.12") (locate pins) Board bottom side: 5 mm from front and rear side board edge (0.2") For Ceramic boards (optional) the non-mountable area can be different	Component height restrictions apply in the 10 mm (0.4") area from front side edge depending on board thickness
PCB Material:	Phenolic/FR4/Composite Materials	Ceramic boards require special conveyor sections (optional)
PCB Positioning:	Locate pin fixation	Adjustable
	Push up pins	Adjustable
	Edge clamping	Adjustable
	Sub stop (PCB waiting buffer)	Adjustable
PCB Transport height:	900 mm \pm 10 mm (35.4" \pm 0.4")	Standard
	SMEMA 953 mm \pm 12.5 mm (37.5" \pm 0.5")	Standard
PCB Transport direction:	Left to Right	Right to Left is optional

Gem Topaz		REMARKS
PCB Transport width:	Automatic	Front rail fixed Rear rail adjustable
PCB Loading time:	Approximately 3 sec.	PCB loading concurrent to SMD picking and alignment
PCB Ratio width/length:	Max. 1:3	
Control system:	MCX controller 486-100	100 MHz, 16 Mb intern. memory
	40 Mb flash disk	Optional 85 Mb
	1.44 Mb floppy drive 3.5"	
	RS 232 Serial Interface	
	15" Color Monitor	
	9" Black/White vision monitor	
User Interface:	VIOS (Visual Integrated Operating System)	
	Hand held keyboard for all operator functions	
	Enhanced PC/AT keyboard for data editing functions	
Control system functions:	Max. 127 PCBs	2280 comp/PCB
	Backup and restoring data using RS232 serial line or floppy	
	Data conversion UFOS↔VIOS	
	Data conversion Text↔VIOS	
	MIS data gathering	
	Data teaching	
	Data tracing	
	Component database	1000 Component packages
	Mark database	300 Mark shapes
	SMEMA electrical interface	
	On line calibration	
	On line help functions	
	Feeder lock verifier	
Machine dimensions and weight:	Length: 1655 mm (5.4 ft)	
	Height: 1865 mm (6.1 ft)	
	Width: 1358 mm (4.5 ft)	Width including feeders 2194 mm (7.2 ft)
	Weight: 1150 kg (2535 Lbs)	
Safety standards:	Optional mechanical safety package	This option is necessary to comply with the European CE safety regulation
	Electrical safety according IEC 204	
Electric Power:	Voltage AC: 200/208/220/240/380/400/416 V ± 10%, 3 Phase	More than 2.5 mm ² cables are needed
	Frequency: 50/60 Hz	
	Consumption: 4 kVA max.	
Air supply:	Pressure: > 5.10 ⁵ Pa (5 bar, 72.5 PSI)	
	Quality: dust and oil free	
	Consumption: 350 Nl/min.	
Operating temperature:	20 - 30°C (68 - 86°F)	
Humidity:	35 - 90% (no dew)	

Table 1

3.0 Features, Accessories and Options

3.1 Features

The standard Gem Topaz includes the following features:

- On the fly alignment using a vision system with a line sensor camera.
- Placement beam with seven standard heads and one Precision Head.
- Simultaneous picking is possible by all 8 heads from any mix of tape feeders. This allows a much higher nominal placement rate and board throughput.
- Handling of complete component range with only 5 nozzles shapes.
- Robust fiducial alignment camera, also used for teaching/tracing and Bad Mark Sensing.
- Automatic width adjustment. The PCB dimensions are part of the PCB data.
- PCB pin-positioning. Second pin is easily adjustable for fast changeover.
- PCB edge clamping system, for PCB's without tooling holes.
- PCB push up plate with 12 push up pins, for PCB support.
- Substop, allowing a second PCB to enter the machine for reducing transport time.
- Feeder lock verification system to avoid damage to the machine due to incorrectly latched feeders.
- Backup and restoring data using RS 232 serial line or 3.5" FDD
- Component dump box.
- Operator manual, available in several languages.
- User manual.
- Service manual.
- Two empty tape bins.
- Toolset.
- First aid spare parts kit.
- CE safety.
- ESD safety.
- Electrical and Mechanical SMEMA.

Standard Software features:

- Easy-to-use VIOS (Visual-Integrated-Operating-System) user interface.
- On-line help function with detailed descriptions of operations and functions on screen.
- Management Information System (MIS) to gather production history data.
- 4 point fiducial correction, to maintain accuracy for stretched/distorted boards.
- Fiducial template matching for PCBs that have no fiducials. (art work recognition)
- Different mark for fiducial pair.
- Fiducial teaching recovery function to allow measurement of damaged fiducials without taking the board(s) out of the machine.
- Data editing functions with the use of the fiducial camera (teaching,tracing).
- A Component Database, that can hold up to 1000 component packages, with the most frequently used components already predefined.
- A Mark Database, that can hold up to 300 mark shapes, with the most frequently used mark shapes already predefined.
- Pre picking, allowing to pick up of components, while the board is being transported practically eliminating board transfer time.
- Alternative feeder function, reducing operator intervention (empty feeder switching).
- Automatic program change over for family boards (self production control).
- Automatic rework cycle to improve operator efficiency including online optimisation which skips empty feeders automatically.
- On-line product preparation and basic program optimization (nozzle and feeder set-up).
- Multi-circuits PCBs can be either be mounted block-by-block or the whole panel can be treated as one single large board by combining the block data. By combining block data, the optimal mounting sequence can be achieved, while the use of block bad marks remains in effect by using sophisticated software.

3.2 Accessories and Options

ACCESSORIES AND OPTIONS TOPAZ	
PA 1912/00	CSM/Gem Glass Adjustment Kit
PA 2505/35	Feederbar exchange system one side factory built in (define rear or front), included FES 50 position cart for FV/GEM
PA 2505/36	FES (Feeder bar exchange) cart 50 position
PA 2505/38	FES head protection unit (only one per machine needed)
PA 2505/39	Modification kit FES 50 position (field retro fit)
PA 2695/11	Manual Tray Feeder GEM
PA 2695/15	Fixed Manual Tray Feeder
PA 2696/20	ATS 27 Tray Feeder for GEM (factory built in at rear side)
PA 2699/21	LCS Tray Feeder for Topaz, Emerald, Eclipse II
PA 2903/20	16 mm Tape Feeder, 15 inch reelholder FV/GEM
PA 2903/30	24 mm Tape Feeder, 15 inch reelholder FV/GEM
PA 2903/40	32 mm Tape Feeder, 15 inch reelholder FV/GEM
PA 2903/50	44 mm Tape Feeder, 15 inch reelholder FV/GEM
PA 2903/74	8 mm Tape Feeder, 2 mm pitch, 7 inch reelholder FV/GEM
PA 2903/75	8 mm Tape Feeder, 4 mm pitch, 7 inch reelholder FV/GEM
PA 2903/76	8 mm Tape Feeder, 4 mm pitch, 15 inch reelholder FV/GEM
PA 2903/80	12 mm Tape Feeder, 7 inch reelholder FV/GEM
PA 2903/81	12 mm Tape Feeder, 15 inch reelholder FV/GEM
PA 2923/00	Set of 20 dummy feeders
PA 2962/72	Nozzle Type 32-2
PA 2962/73	Nozzle Type 33
PA 2962/74	Nozzle Type 34
PA 2962/75	Nozzle Type 31
PA 2962/76	MELF Nozzle
PA 2962/78	Nozzle Type 31-1 Topaz head one (spring loaded)
PA 2963/15	Nozzle Exchange System Topaz (12 position/no nozzles incl.)

PA 2969/50	Second line sensor camera for Topaz
PA 2969/90	Area CCD camera (including forelighting) for Topaz
PA 2981/10	Pallet for LCS Tray Feeder FV/GEM
PA 2981/30	Pallet for PA 2696/20 (ATS 27)
<i>FV indicates Comet I/II, Eclipse I/II and Orion family of machines</i>	

Table 2

4.0 Mounting Heads Configuration

The Gem Topaz features a high precision placement beam carrying 8 heads with exchangeable nozzles, one of which is specially designed for high precision QFP placement and a separate camera system that monitors fiducial marks at the board, circuit and component level, using white-light LEDs and multi-angle diffusers to provide optimal illumination. High placement rates are achieved by simultaneous component picking which reduces head beam travel and thus shortens the mounting cycle.

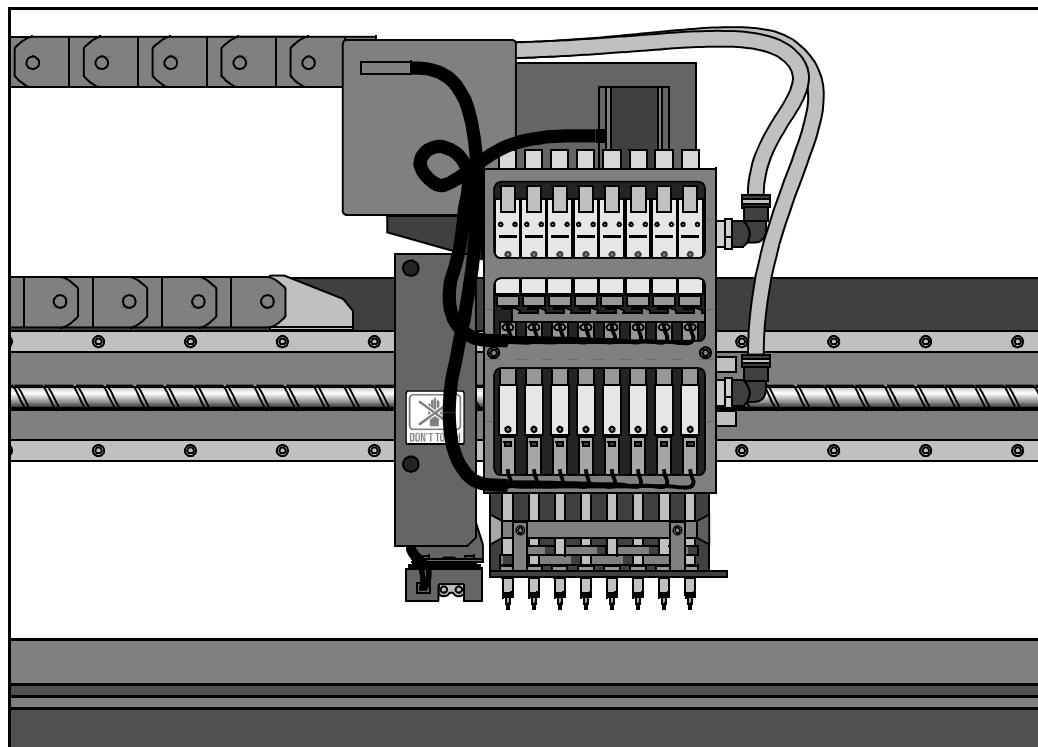


Figure 2 Configuration of head section.

The high-precision Topaz features four-axis (X,Y,Z,R) servo control for accurate, stress-free component mounting. Direct Drive, brushless AC motors controlling heavy duty lead screws allow optimal accuracy and superb reliability.

SPECIFICATIONS	
Applicable Components:	0402 - SOP, SOJ, PLCC 25 mm \square (1.0")
	QFP 21 mm \square (0.83") with pin pitch down to 0.65 mm (25 mil), using line sensor camera
	QFP 32 mm \square (1.26") with pin pitch down to 0.5 mm (20 mil), using optional area CCD camera
Mounting accuracy (x,y) 3σ :	0.08 mm for chips and SOIC with line sensor camera
	0.06 mm for QFPs using precision head and optional area CCD camera system
Placement tact time:	0.3 sec for 8 x nozzle type 31 (chips)
	0.65 sec for 4 x nozzle type 32 (SO ICs)
Encoder resolution:	X,Y = 2.5 μ m
	Phi = 0.009°
Head position repeatability:	X = 0.010 mm
	Y = 0.010 mm
Speed:	X = 1500 mm/sec
	Y = 1500 mm/sec
Acceleration:	X = 31000 mm/sec ²
	Y = 19000 mm/sec ²

Table 3

5.0 Alignment

5.1 Line Sensor Alignment

The high speed of the Gem Topaz is achieved by fast on-the-fly component alignment using a revolutionary line sensor system that is four times faster than conventional systems. For ultimate speed, the machine can be equipped with a second line sensor camera which reduces head beam travel and thus shortens the mounting cycle.

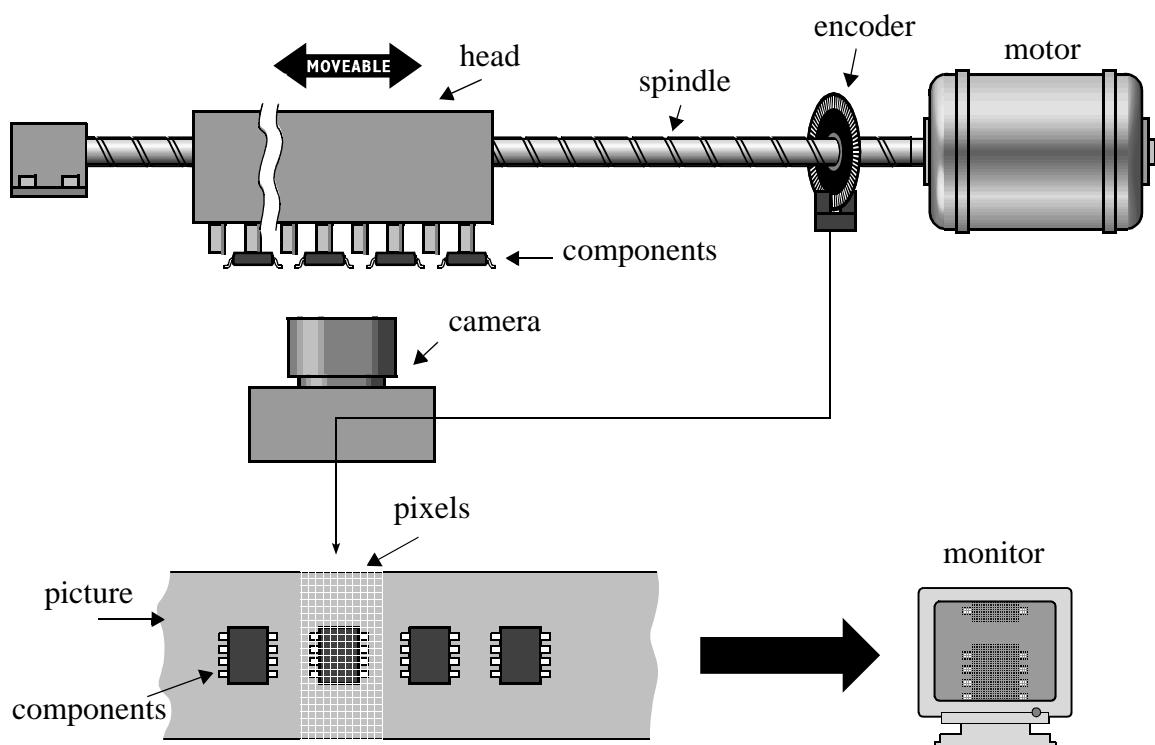


Figure 3 *Line sensor vision principle.*

While moving the beam over the camera, the encoder triggers the camera to capture consecutive lines of pixels. All these lines form the total picture of the components. This picture is processed by a sophisticated vision system. The vision system algorithms inspect the components and calculate position and orientation of the components on the heads.

The SMD components are illuminated by fore lighting/reflective lighting. The leads of the components are imaged on the line sensor.

SPECIFICATIONS	
Line sensor camera:	CCD 2048 x 1 pixels
Max. component size:	25 mm \square (1.0")
Min. component size:	0402
Min. lead pitch:	0.65 mm (25 mil)
Min. lead width:	0.2 mm (0.004")
Grey scale:	256 levels
Lighting:	Fore lighting (red LED array)
Recognition:	Reflection. Pattern recognition on all leads
Max. nr lead sides:	4
Max. nr lead groups:	2 per side
Check on:	Lead pitch Lead location Bent/missing leads Total number of leads Cumulative lead pitch
Applicable components:	0402 - SOP, SOJ, PLCC 25 mm \square (1.0") QFP 21 mm \square (0.83") with pin pitch down to 0.65 mm (25 mil) Irregularly shaped SMDs like CONNECTOR TSOP / VSOP
Component definition:	Physical data entry (from data sheet)

Table 4

5.2 Area CCD Alignment

An optional area CCD camera extends the component range for the Gem Topaz Precision Head.

Component illumination is performed by means of fore lighting/ reflective lighting. Fore lighting reflects the lead of QFP and the balls of BGA components on the CCD camera. The area CCD camera grabs the image of the component in one frame and presents it to the vision system for recognition and measurement purposes.

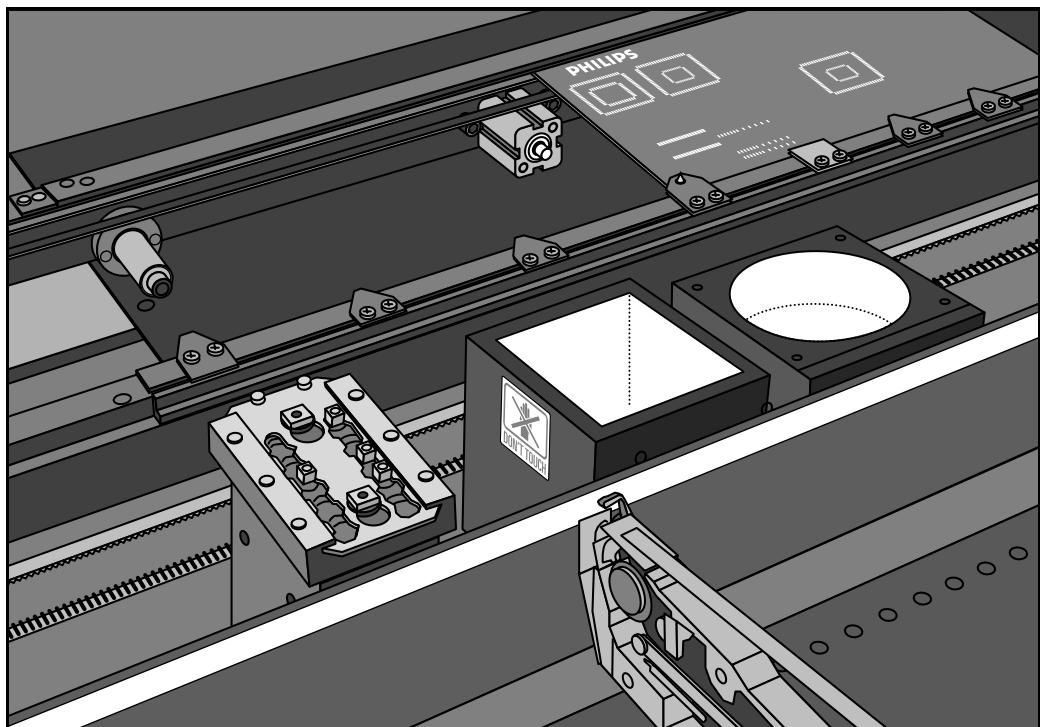


Figure 4
Gem Topaz working area.

SPECIFICATIONS	
Area CCD Camera:	CCD 512 x 480 pixels
Max. component size:	32 mm \square (1.26")
Min. component size:	6 mm \square (0.24")
Min. lead pitch:	0.5 mm (20 mil)
Min. lead width:	0.2 mm (0.008")
Grey scale:	256 levels

SPECIFICATIONS	
Lighting:	Fore lighting (red LED array)
Recognition:	Reflection. Pattern recognition on all leads
Max. nr lead sides:	4
Max. nr lead groups:	2 per side
Check on:	Lead pitch Lead location Bent/missing leads Total number of leads Cumulative lead pitch Total BGA balls
Applicable components:	QFP 32 mm \square (1.26") with pin pitch down to 0.50 mm (20 mil) CONNECTOR Only dark background BGAs max. 32 mm \square with min. ball pitch 1.27 mm (50 mil)
Component definition:	Physical data entry (from data sheet)

Table 5

5.3 Fiducial Alignment

The Gem Topaz is standard equipped with a fiducial camera. This camera is used to compensate for variations in the position of the circuit pattern relative to the expected position. The fiducial alignment system is an opto-electronic system which performs geometric measurements of fiducial marks on the PCB in order to calculate the deviations from their expected positions. The system can use two or four fiducials per board. Each subcircuit can also be aligned using two fiducials. For placement of fine-pitch components two local fiducials per component may be used. The individual shapes of a fiducial pair can be different to allow for maximum application flexibility.

SPECIFICATIONS	
Fiducial camera:	CCD
Fiducial illumination:	White-light LEDs in conjunction with a multi-angle illumination
Compensation for: (with two fiducials)	Translation
	Rotation
	Linear stretch and shrink
Compensation for: (with 3 or 4 fiducials)	Non-linear stretch and shrink
Type of compensation:	PCB, Block, Local
Fiducial size:	Max. 3.0 mm (0.12")
	Min. 0.8 mm (0.03")
Fiducial material:	Copper Gold Lead-tin
Fiducial clearance area	2 x Fiducial size
PCB warpage at fiducial:	Max. 0.5 mm (0.02")
Pattern offset:	Max. 1 mm (0.04")
Number of different Fiducial pairs per PCB:	128
Number of fiducial shapes in Mark Database:	300
Examples of fiducials:	Solid circle (preferred) Square Triangle Donut Binary cross Bow-tie (connected) Template matching (art work)
Fiducial definition:	According CAD data

Table 6

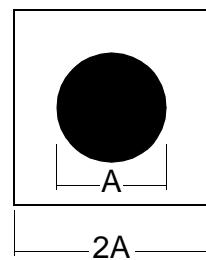


Figure 1

Fiducial free space.

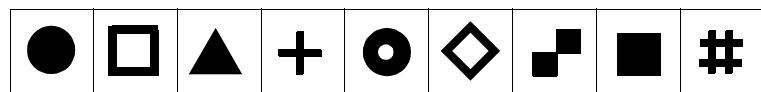


Figure 2

Examples of fiducials.

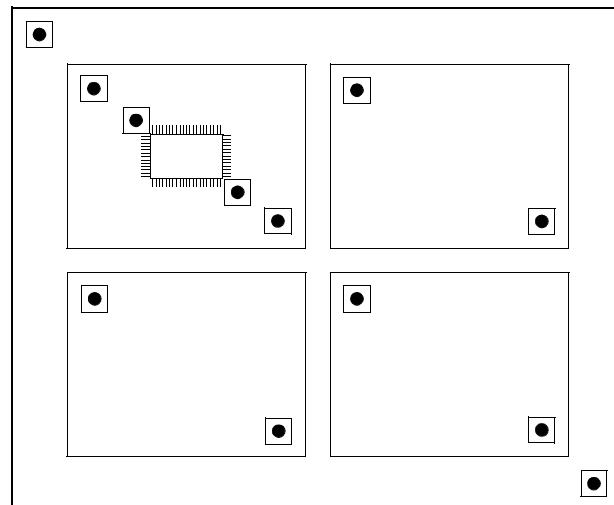


Figure 3

Examples of PCB, block and local fiducials.

5.4 **Bad Mark Sensing & Master Mark Sensing**

If the PCB contains subcircuits, one or more of these subcircuits can be skipped for placement by giving them a “Bad Mark” on a designated position on the subcircuit. No parts will be placed on a circuit that has a Bad Mark. Bad Mark sensing, with the use of the fiducial camera, is based on recognition of a difference in contrast in a certain area. This area can be defined in the machine software (position and area-dimensions). This gives maximum freedom in choosing the process or technique to add Bad Marks, for example:

- white or light colored labels of any dimension,
- white paint,

... or any other material that can be fixed as long as it contrasts with the PCB surface.

Before checking the Bad Marks on all circuits, the Master Mark may be checked first. Presence of a Master Mark means that one or more Bad Marks are present on the circuits. This allows the machine to skip the Bad Mark sensing process for all circuits if no Bad Marks are located on the circuits, therefore saving valuable production time.

6.0 Board Handling

PCB boards can be located in the machine by either tooling pins or edge clamping if tooling holes are not available. With Pin location, one location pin is fixed on the machine while the other locate pin is easily adjustable when the board length changes. Change over to a different board size is just a matter of seconds.

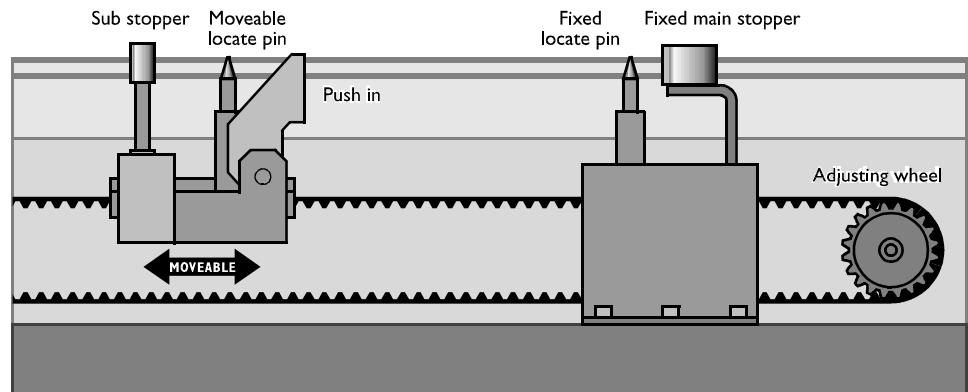


Figure 5 Pin fixation system.

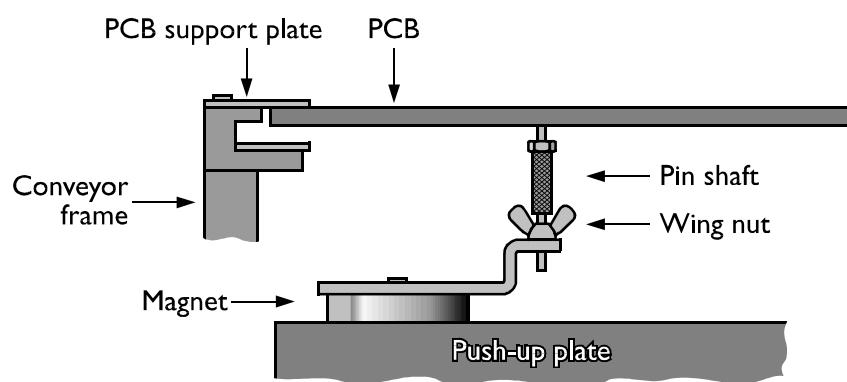


Figure 6 Push up system.

The Edge Clamping system is as easy to adjust as the locate pin fixation. Both these systems use Push-up pins to support the PCB.

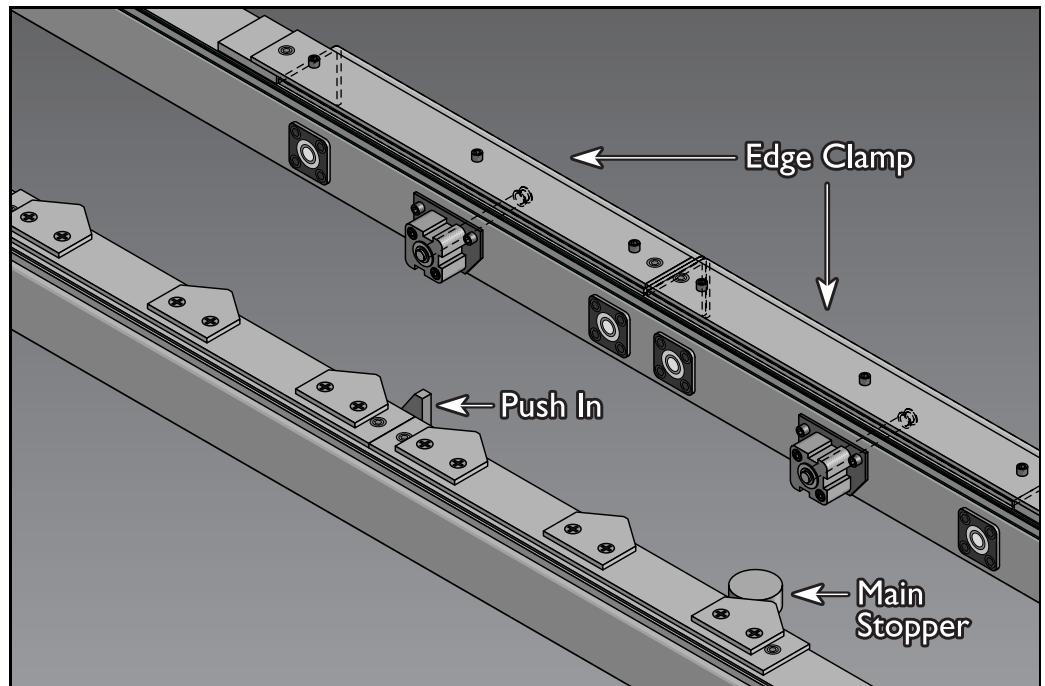


Figure 7
Gem Topaz Edge Clamping system.

A Sub-stop enables an additional PCB to enter the machine while the current board is being populated. This reduces time loss during transport and is very useful when operating the machine in a flowline.

When using the machine in a flowline, it communicates with the unit upstream and downstream over a SMEMA-connection.

SPECIFICATIONS	
PCB Dimensions (x,y):	Min. 50 mm x 50 mm (2.0" x 2.0") Max. 457 mm x 407 mm (18" x 16") using PCB pin fixation Max. 440 mm x 407 mm (17.3" x 16") using PCB edge clamping system Optional 558 mm x 508 mm (22" x 20"). For this option, line sensor camera, nozzle station mounted at machine REAR side. No front line sensor camera possible. Amount of rear side feeder positions is limited.
PCB Thickness:	Min. 0.6 mm (0.02") Max. 3.0 mm (0.12")
Reference hole position:	5 mm (0.2") in X and Y from lower right corner
Reference hole diameter:	Ø 2.0 mm-Ø 4.0 mm (0.08" - 0.157")

SPECIFICATIONS	
PCB Maximum warpage:	0.5 mm up (0.02") 1.0 mm down (0.04")
Max. height pre-mounted components:	6.5 mm on placement side (0.26") 15 mm on non placement side (0.6")
Non-Mountable area:	<p>Board Top side: 3 mm from rear side board edge (0.12") 0 mm from front side board edge (Component height restrictions apply in the 10 mm (0.40") area from front side edge depending on board thickness) 3 mm around reference holes (0.12") (locate pins)</p> <p>Board Bottom side: 5 mm from front and rear side board edge (0.2") For Ceramic boards (optional) the non-mountable area can be different</p>
PCB Material:	Phenolic/FR4/Composite Materials Ceramic boards require special conveyor sections (optional)
PCB positioning:	Locate pin fixation Push up pins Edge clamping Sub stop (PCB waiting buffer)
PCB Transport height:	900 mm \pm 10 mm (35.4" \pm 0.4") SMEMA 953 mm \pm 12.5 mm (37.5" \pm 0.5")
PCB Transport direction:	Left to Right
PCB Transport width:	Automatic
PCB loading time:	Approximately 3 sec.
PCB ratio width/length:	Max. 1:3

Table 7

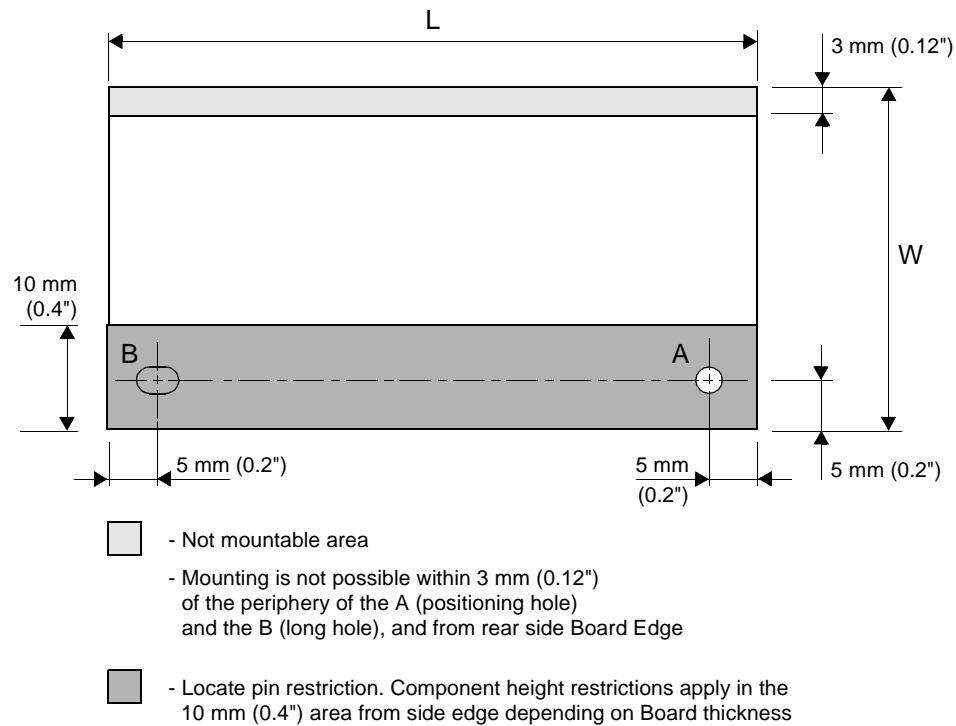


Figure 8 Mountable area.

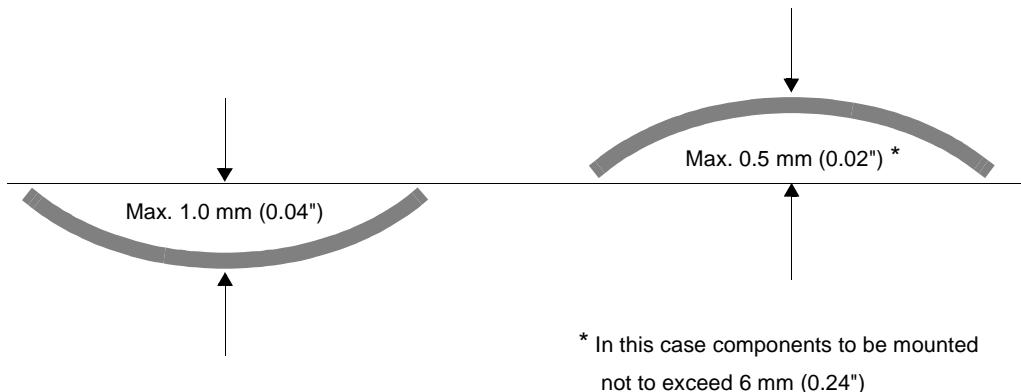


Figure 9 Warp of fixed PCB.

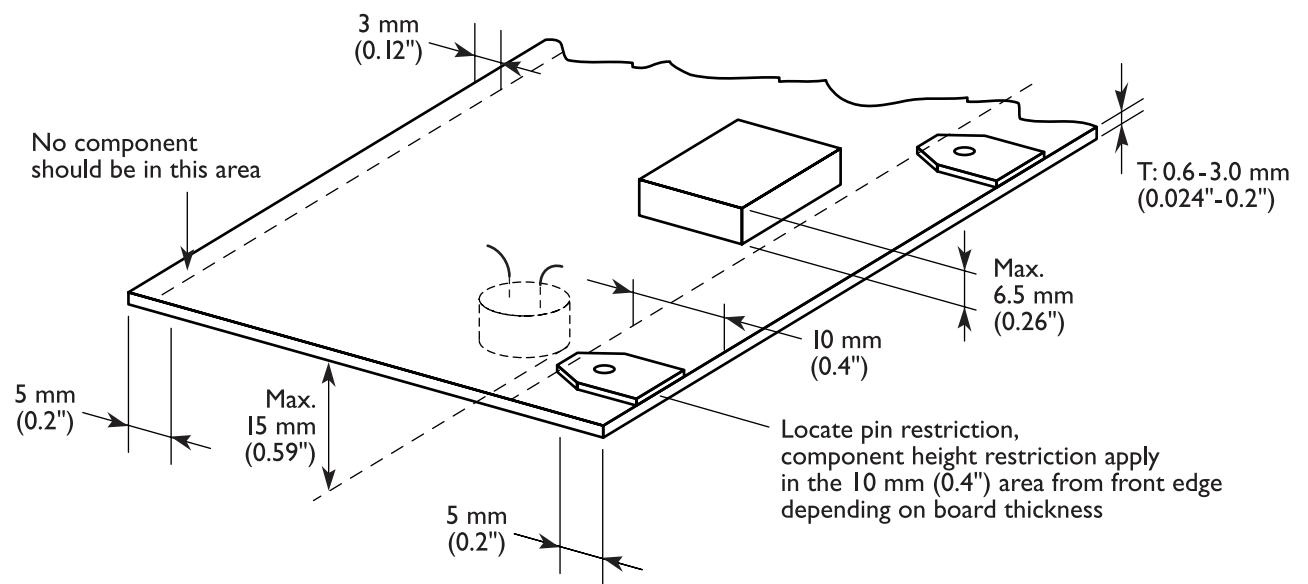


Figure 10

Mountable area.

7.0 Component Handling

7.1 Feederbar Exchange System PA 2505/36

The Feederbar Exchange System (FES) allows fast change-over by switching the complete feederbar.

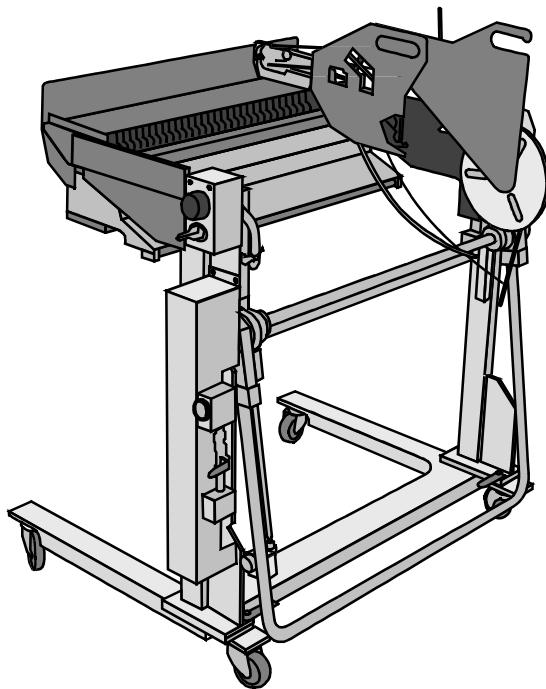


Figure 11 FES carriage.

Feederbars are mounted on carts to allow for off-line feeder set-up. These carts are easily moved from set-up area to the mounting machines and back. This option is available for the front and rear side of the machine without loss of feeder positions or any other technical restrictions. To prevent any damage during feederbar exchange, a FES head protection unit permits feederbar exchange only when the head assembly is parked in the middle of the machine.

Topaz FES carts are compatible with those of the Emerald and Sapphire. An empty tape bin will be delivered with each FES cart.

FES SPECIFICATIONS	
	FES 50 position
FES change over time:	≤ 60 sec
FES repeatability:	Pick position ≤ 0.15 mm
Applicable feeders:	Tape, stick, bulk feeders
Number of feeders on FES cart:	8 mm: 50 positions 12/16 mm: 24 positions 24 mm: 16 positions 32 mm: 16 positions 44 mm: 12 positions 56 mm: 9 positions Stick: depends on stick dimensions
Electrical interface:	Round 72 pin connector
Electrical power:	Supplied by main system
Pneumatic interface:	Quick connect coupling
Air supply:	Supplied by main system
FES dimensions, stand alone without feeders:	Length: 1070 mm (3.5 ft) Width: 650 mm (2.1 ft) Height: 920 mm (3.0 ft)
Weight without feeders:	76 kg (167 Lbs)
Mechanical items:	Feederbar for 50 x 8 mm feeders Cast iron feederbar frame Cast iron trolley
Compatibility:	CSM Orion, CSM Eclipse II, Gem Emerald
<i>The FES specifications are valid for the use at SMEMA height.</i>	

Table 8

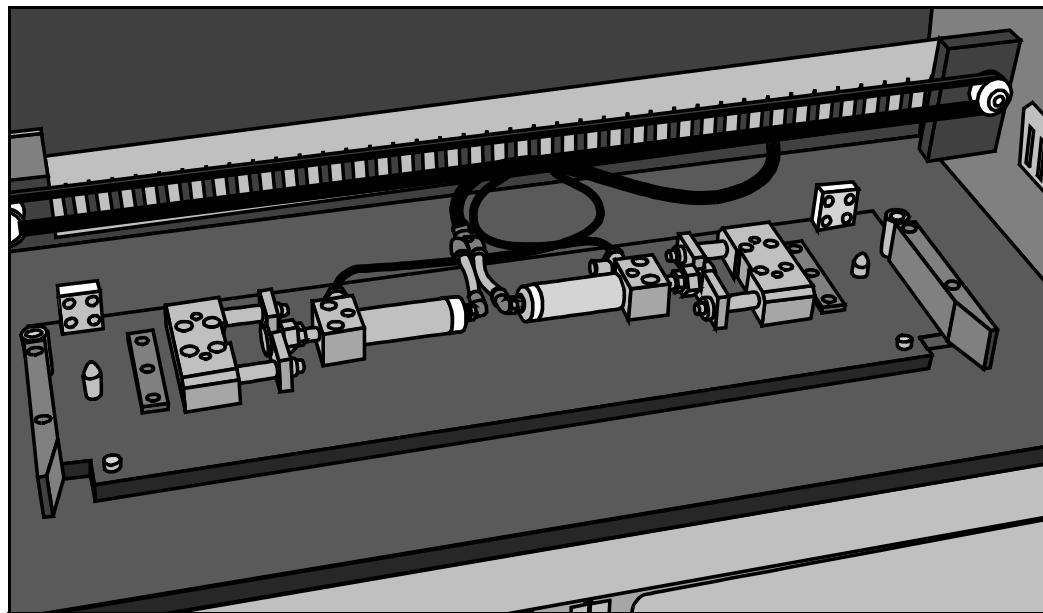


Figure 12 *FES interface.*

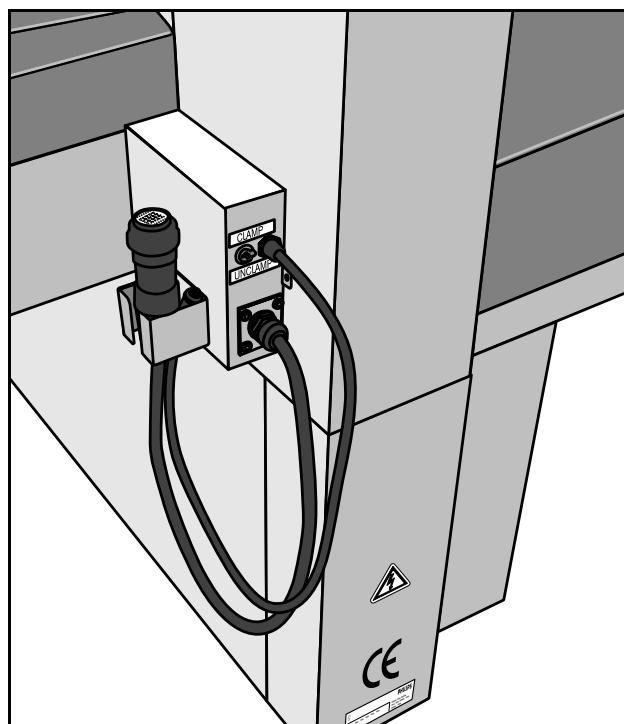


Figure 13 *Interface box with pin connector and a pneumatic quick connect coupling.*

7.2 LCS Tray Feeder PA 2699/21

The LCS Tray Feeder is an additional pallet sequencer feeding parts from a tray. This feeder can be equipped with a maximum of 50 pallets, each being able to hold different trays.

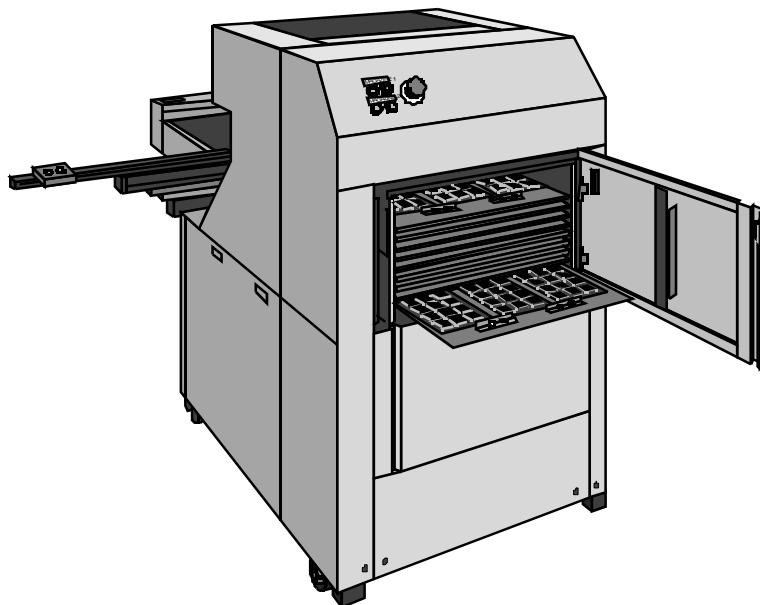


Figure 14

LCS Tray Feeder.

Two or three components are picked up from the tray and placed on a shuttle. This shuttle transports the components into the machine for pick-up and mounting by the placement heads.

The cycle time of the Tray feeder is 5.0 seconds for 3 parts when using the same tray and 6.5 seconds when changing the tray. However, in practice no time is lost because of the simultaneous operation of Tray Sequencer and Topaz: while the machine is picking from on-board feeders, the shuttle brings in new components.

A part rejected by vision will be placed back on the shuttle and returned to its original tray position; this means no loss of expensive parts.

- The PCB buffer conveyor on the Tray Feeder offers the possibility for visual PCB inspection and allows linking with downstream machines.
- The tray container is separated into two sections with each 25 pallets. This allows tray replenishment while the machine is running.

LCS TRAY FEEDER SPECIFICATIONS	
GENERAL	
Max. Tray size (L x W):	350 mm x 468 mm (13.7" x 18.4")
Cycle time:	5.0 sec. for 3 parts (picking from same tray) 6.5 sec. for 3 parts (picking from two trays) However, in practice no time is lost because of the simultaneous operation of Tray Sequencer and Topaz: while the machine is picking from on-board feeders, the shuttle brings in new components
Power and air supply:	Delivered by Topaz
LCS Tray feeder dimensions:	Length: 773 mm (2.5 ft) Height: 1165 mm (3.8 ft); with top cover open 1520 mm (5.0 ft) Width: 1595 mm (5.2 ft); with door open 2175 mm (7.1 ft)
Topaz + Tray feeder dimensions:	Length: 2423 mm (8.0 ft) Height: 1865 mm (6.1 ft) Width: 1818 mm (6.0 ft); with LCS door open and feeders on Topaz 2791 mm (9.2 ft)
Weight:	± 250 kg (551 Lbs)
APPLICABLE COMPONENTS	
Min. Component dimension:	8 mm x 8 mm (0.31" x 0.31") Mold size
Max. Component dimension:	54 x 54 mm (2.1" x 2.1")
Max. Tray height included component height:	6 mm (0.24") from pallets at pitch of 10 mm (0.4"), total 50 pallets possible
Max. Tray height included component height:	16 mm (0.63") from pallets at pitch of 20 mm (0.79"), total 26 pallets possible
FEED CAPACITY	
Nozzles on shuttle:	3
STANDARD COMPONENT CAPACITY	
Max. number of component types:	150
Number of pallets:	Standard 40 pallets included (additional pallets available PA 2981/10)

Table 9

**7.3 ATS 27
Tray Feeder
PA 2696/20**

The ATS 27 Tray Feeder is a new additional internal pallet sequencer, allowing high-speed feeding of tray components. This feeder can be equipped with a maximum of 27 pallets, each being able to hold different trays.

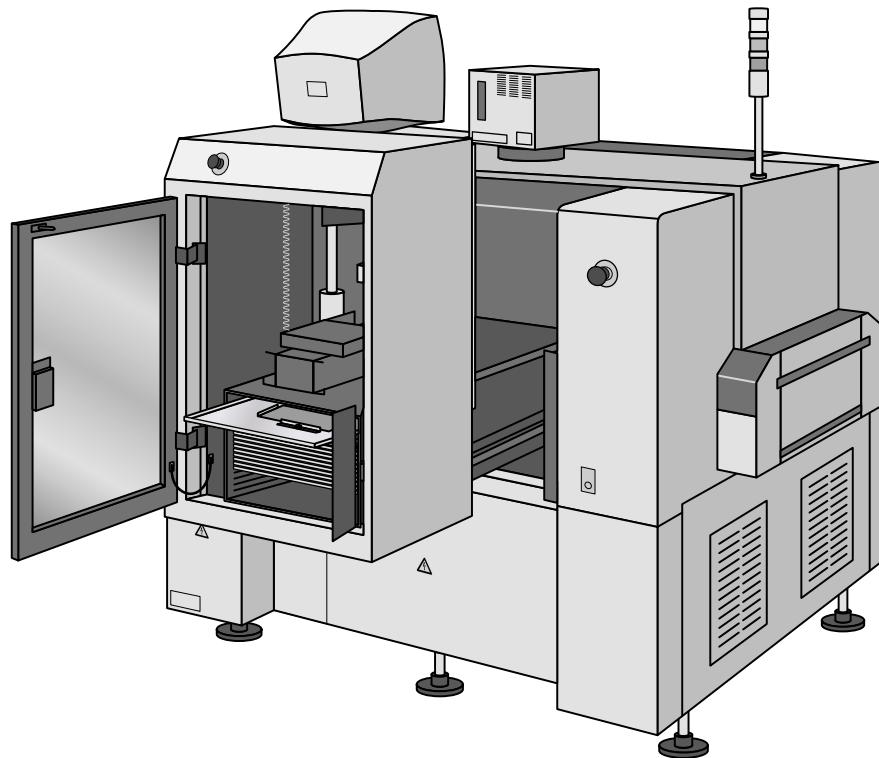


Figure 15 ATS 27 Tray Feeder.

The maximum pallet exchange time for the ATS 27 Tray feeder is 5.0 seconds. However, in practice no time is lost because of the simultaneous operation of the ATS 27 Tray Sequencer and Topaz; while the machine is picking from on-board feeders, the pallet brings in new components.

A part rejected by vision will be placed back in its original tray position; this means no loss of expensive parts.

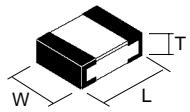
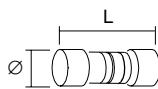
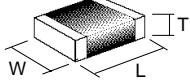
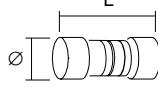
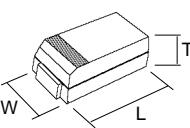
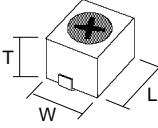
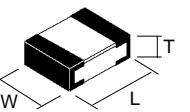
ATS 27 TRAY FEEDER SPECIFICATIONS	
GENERAL	
Max. Tray size (L x W):	364 mm x 222 mm (14.3" x 8.7").
Pallet exchange time:	Changing from pallet 1 to 27; 5 seconds However, in practice no time is lost because of the simultaneous operation of the ATS 27 Tray Sequencer and Topaz; while the machine is picking from on-board feeders, the pallet brings in new components.
Power and air supply:	Delivered by Topaz.
Topaz + ATS 27 Tray feeder dimensions:	Length: 1655 mm (5.4 ft) Height: 1865 mm (6.1 ft) Width: 1761 mm (5.8 ft); with ATS 27 door open: 2267 mm (7.4 ft)
Maximum board size Topaz:	250 mm (9.8") and no second line sensor camera possible
APPLICABLE COMPONENTS	
Max. Tray height included component height:	6 mm (0.24") from pallets at pitch of 10 mm (0.4"), total 27 pallets possible.
Max. Tray height included component height:	16 mm (0.63") from pallets at pitch of 20 mm (0.79"), total 13 pallets possible.
STANDARD COMPONENT CAPACITY	
Number of pallets:	Standard 20 pallets included (additional pallets available PA 2981/30)

Table 10

7.4 Mountable Components & Required Nozzles

Gem Topaz

Just five nozzle shapes are required to cover the specified SMD range. High output levels are therefore achieved, as the need for nozzle exchanges is minimal. An optional 12 position nozzle exchange station enables additional special nozzles to be accommodated.

COMPONENTS	DIMENSION (mm)			REQUIRED NOZZLE
	Solid resistor	L	W	T
		1.00	0.50	0.50
		1.60	0.80	0.50
		2.00	1.25	0.50
	Solid resistor	2.00	\varnothing 1.25	
		3.45	\varnothing 1.35	
	Multi-Layered ceramic capacitor	1.50	0.80	0.80
		2.00	1.25	1.25
		3.20	1.60	1.25
		3.20~4.50	2.50~3.20	1.50~1.90
		5.60	5.00	1.90
	MELF ceramic capacitor	3.40	\varnothing 1.50	
	Tantalum electrolytic capacitor	2.90	1.60	1.60
		3.80	2.90	1.60
		4.70	2.60	2.10
		6.00	3.20	2.50
		7.30	4.30	2.80
	Aluminium electrolytic capacitor	4.3	4.3	5.7
		6.6	6.6	5.7
	Chip film capacitor	7.3	5.3	3.25
				Type 32-2

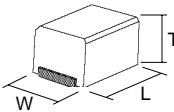
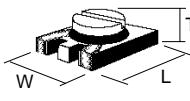
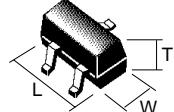
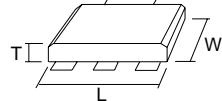
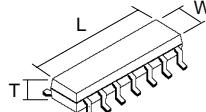
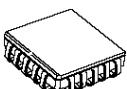
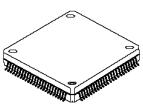
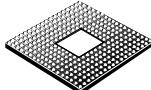
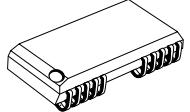
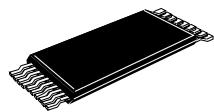
COMPONENTS		DIMENSION (mm)			REQUIRED NOZZLE
		L	W	T	
	Chip inductor	3.2	2.5	2.0	Type 31
		4.5	3.2	3.2	Type 32-2
	Semi-variable resistor	4.5	3.8	2.4	Type 32-2
	Transistor (SOT)	2.90	1.5	1.10	Type 31
		4.0	3	1.8	Type 32-2
	Power transistor	4.6	2.6	1.6	Type 32-2
	SOP (6 ~ 28 pin)	5.00	4.50	1.50	Type 32-2
		10.10	4.50	1.50	Type 32-2
		12.60	5.70	1.50	Type 32-2
		15.30	7.50	2.00	Type 32-2
		17.80	7.50	2.00	Type 32-2
	PLCC	<input checked="" type="checkbox"/> 6~12.5 (below 1.1 g)			Type 32-2
		<input checked="" type="checkbox"/> 10~25 (below 2.0 g)			Type 33
		<input checked="" type="checkbox"/> 18~45 (below 6.2 g)			Type 34
	QFP	<input checked="" type="checkbox"/> 6~14 (below 0.6 g)			Type 32-2
		<input checked="" type="checkbox"/> 8~25 (below 2.0 g)			Type 33
		<input checked="" type="checkbox"/> 18~45 (below 5.3 g)			Type 34
	BGA	max. <input checked="" type="checkbox"/> 21			Type 33
		max. <input checked="" type="checkbox"/> 32			Type 34
	SOJ (20 ~ 42 pin)	max. <input checked="" type="checkbox"/> 21			Type 32-2
		max. <input checked="" type="checkbox"/> 32			Type 33
	TSOP (20 ~ 32 pin)	max. <input checked="" type="checkbox"/> 30			Type 32-2 Type 33 Type 34

Table 11

8.0 Computer Aided Production Support System (CAPSS)

8.1 Introducing CAPSS

Philips' Computer Aided Production Support System consists of a powerful set of software modules designed to reduce the time required to bring products from design to production. CAPSS is a reliable approach to support the flexible structure of a Philips SMD assembly line.

8.2 GPP: Converting CAD Data

The GPP is a template based tool which converts/combines CAD data and Bill-Of-Material data. The template creation utility, which is a part of GPP, allows you to simply create conversion templates for each CAD system.

8.3 PPS: Program Generation

The PPS software module allows for the off-line creation of:

- machine programs
- set-up and operator instructions
- process information.

Automatic optimization of the machine programs and line balancing of the workload increases the utilization and productivity of the placement line, while preparing the program off-line decreases the line down time taken up by these activities without PPS.

Computer Aided Production Support System Architecture

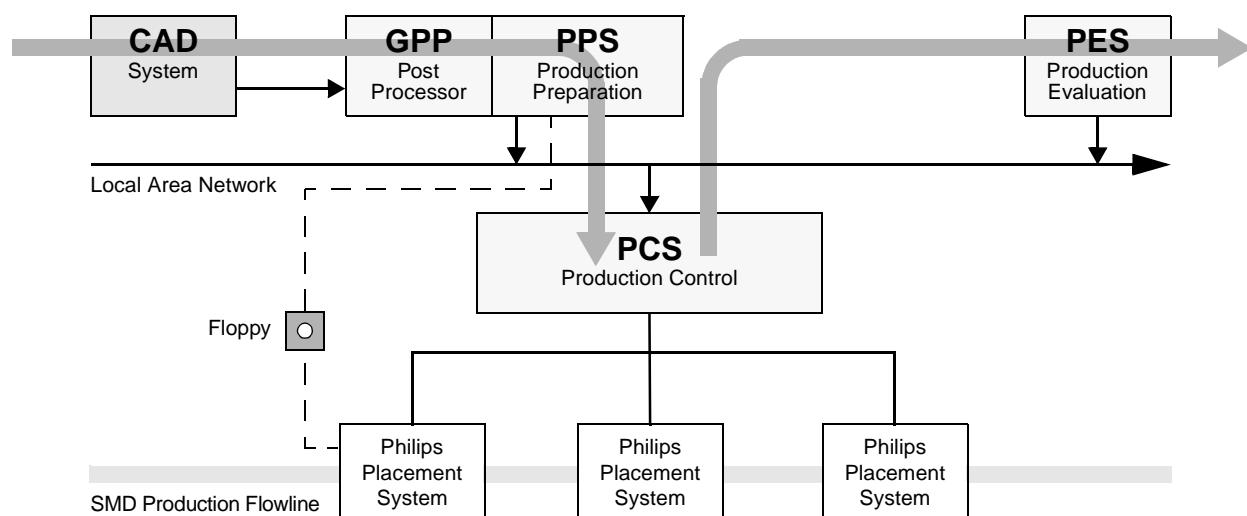


Figure 16 Computer Aided Production Support System architecture.

Viewing CAD data:

The converted CAD data is compiled into the database of PPS. There it can be interactively updated with new assembly data. PPS shows a complete graphical representation of the resulting board, enabling CAD data verification.

The Basic PPS software module includes a comprehensive package specification library which guarantees a minimum start-up effort and ensures reliable data to support program generation.

Program optimization:

Machine properties, feeder locations and board definitions are considered for maximum throughput. Program pattern optimization ensures efficient movements for pick-and-place as well as for glue dispensing.

8.4 Line Balancing

Automatic line balancing assigns the components to the appropriate machines suitable for a single board or family board production. PPS's comprehensive machine modelling provides accurate estimates of machine cycle times.

Program generation:

Automatic program generation of downloadable programs, set-up and operator instructions and process information minimizes the time required for setting up a machine for production at product changeover.

PPS configurations:

The PPS software is available in several configurations, allowing different degrees in features and cost variations. The building blocks are:

- Basic PPS
- Optimizer Package
- Extended PPS.

First Configuration: Basic PPS for:

- CAD links
- machine program generation
- program download.

Second configuration: Basic PPS + Optimizer package:

- CAD links
- Machine program generation
- Machine (single) optimization
- Program download.

Note: The Optimizer package is an extension to the Basic PPS software module and cannot be used separately.

Third configuration: Basic PPS + the Optimizer package + Extended PPS:

- CAD links
- Automatic line balancing for up to six machines
- Machine optimization
- Automatic program generation
- Program download.

Note:

The Extended PPS is an extension requiring both the basic PPS and the Optimizer package and cannot be used separately.

8.5 PCS: Production Control System

The Production Control System, located on the shop-floor, provides a tool for down- and up-loading programs and monitoring one or more machines. Programs generated by PPS are provided through a local area network link or floppy disk. PCS controls the entire line as a single unit - all from the unique graphical interface using simple icons and button bars. PCS enables production orders to be entered by the shop-floor personnel or a shop-control-system via a local area network. PCS provides a backup and restore facility for crucial machine data.

Control of multiple lines:

Flexible line configuration allows shop-floor personnel to select the number of lines to be controlled by each PCS. A single PCS workstation can control up to 5 lines simultaneously, each with a maximum of 10 equipment stations, up to a total of 20 equipment stations.

Evaluation with PES:

The PCS collects information on the production process and the products produced for each order. This information is sent to the included Production Evaluation System (PES). PES collects, formats and displays manufacturing process and production data collected over a particular product batch or production run. Since PES is based on a spreadsheet software package, reports can easily be changed to any report-format.

SYSTEM REQUIREMENTS	
PC IBM compatible, specifications:	486 DX System or Pentium System
	Clock speed 33 MHz or higher
	16 Megabytes of memory
	360 Megabytes hard disk or more
	At least one high density diskdrive (3.5")
	A VGA card and color monitor and a mouse
	OS/2 Warp 3.0 or 4.0, includes support for Win 3.X
Extra for PPS:	CD Rom supported by OS/2 Warp 3.0 or 4.0
Network Interface:	Network software providing NFS functionality, for example TCP/IP for OS/2 Total Kit from IBM

Table 12

PRODUCTION SUPPORT SYSTEM PRODUCT MATRIX			
	PA Number	Product	Features
General Post Processor	PA 2213/02	GPP 3.0 for Excel (Besides Win. 3.X, Windows 95 or Windows NT is part of the pack)	<p>Template based tool for CAD data conversion</p> <p>Easy to use template creation utility</p> <p>Example templates for:</p> <ul style="list-style-type: none"> - CSM/Gem program to FTIP - FTIP to CSM/Gem program - Fuji program to FTIP <p>Standard templates available with: Mentor 7.1, Scicards CII, CADnetics TOP-CAD, PCAD, etc.</p>
Production Preparation System	PA 2220/03	CSM/GEM-PPS 3.0 Basic Package	<p>Automatic generation of programs, set-up and operator instructions and process information for a single machine</p> <p>Compiling and viewing of CAD data</p> <p>Package specification library</p> <p>Supports all CSM/Gem machine types</p>
	PA 2221/03	CSM/GEM-PPS 3.0 Optimizer	<p>Enables automatic program generation of fully optimized CSM/Gem equipment programs</p> <p>Provides accurate estimates of machine cycle times</p>
	PA 2222/03	CSM/GEM-PPS 3.0 Extended	<p>Extends the functionality of the CSM/Gem-PPS 3.0 Basic Package by allowing automatic program generation for up to six CSM/Gem machines in line</p> <p>Automatic line balancing increases the utilization and productivity of the placement line</p>
Production Control System	PA 2230/03	PCS 2.1 - 1 user	<p>Transfer of programs and data between PC and CSM machines</p> <p>Controlling equipment individually and as a line</p> <p>Real-time monitoring, display and handling of:</p> <ul style="list-style-type: none"> - Process/Production status. - Production Equipment alarms. <p>Product, process and equipment data collection</p> <p>Backup and restore facility for crucial machine information</p> <p>Graphical interface using simple icons and button bars</p> <p>Includes Production Evaluation System (PES)</p>
	PA 2231/03	PCS 2.1 - 3 users	Licence to run PCS on three (3) different PCs
	PA 2233/03	Update to PCS 2.1	

Table 13